RICH Leak Check Procedure

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Approval Signatures

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10-2-98
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REVISION CONTROL SHEET

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A	First Issue	2/19/02	J. Rank	J. Rank, A. Etkin, W. McCabe, Y. Makdisi, A. Frawley	n/a
-	Made Inactive 8/24/2009	8/24/2009	Inactive Comment by D. Lynch	D.Lynch, R. Pisani, P. Giannotti	R. Pisani

0.0 Purpose and Scope

0.1 The purpose of this procedure is to provide directions for leak checking the PHENIX Ring Imaging Cherenkov detectors in building 832, prior to shipping them to building 1008 for installation in the PHENIX carriage. There will be no further leak checking (other than routine in-place pressure drop testing) before the changeover from CO2 to ethane.

1.0 Responsibilities

1.1 All operations shall be performed under the direction of the RICH chief mechanical physicist (Tony Frawley). All personnel involved in the procedure in any way will be trained in the procedure and the use of the equipment by the RICH chief mechanical physicist.

2.0 Prerequisites

2.1 All personnel involved in this procedure shall have reviewed the procedure and be fully conversant with the precautions listed in section 4.1 dealing with prevention of oxygen deficiency hazard to personnel, and with the operation of the gas system.

3.0 Equipment List

3.1 The following equipment is required for this procedure:

A gas handling system for flowing gas through the RICH vessel, and controlling and monitoring the internal pressure (see figure 1).

A Matheson Leak Hunter Plus model 8066 leak sniffer. The Matheson Leak Hunter Plus model 8066, when used as an argon leak sniffer, has the following specifications for minimum detectable leak rate and concentration:

- 4.9×10^{-4} liters/hour min. detectable leak rate.
- 2,200 ppm argon minimum detectable concentration.

About 16 bottles (about 100,000 liters at 1 atmosphere) of argon gas will be used over a period of about 5 days.

4.0 Precautions

4.1 Because the leak check procedure is carried out using argon gas (specific gravity 1.3), precautions must be taken against the possibility of causing an oxygen deficiency hazard to personnel. The procedure described in this document

contains the following precautions that are designed to ensure that no oxygen deficiency hazard occurs:

4.1.1 A maximum flow rate of 35 liters/min of argon gas, limited by a manual valve.

4.1.2 Whenever the RICH vessel contains argon, or argon is flowing, the large sliding door at the south end of building 832 is to be open to the outside, and the south wall of the RICH assembly tent will have been removed.

4.1.3 Exhaust gas from the bubbler will be piped outside the building using 50 feet of 1" diameter plastic tubing.

4.1.4 Large leaks will be found and fixed early in the procedure, when the RICH vessel contains a small percentage by volume of argon. Argon flow will be stopped while leaks are being repaired.

4.2 The RICH internal pressure must never exceed 1.5" above ambient pressure. This could result in damage to the window support beams.

5.0 Procedures

Refer to figure 1 (attached) while reading all procedures.

5.1 First pressurization of RICH vessel to 0.5"

The purpose of this procedure is to provide directions for the first pressurization of the RICH vessel. This is a check for gross leaks in the vessel.

The Rich volume is 40,000 liters and it will initially contain air. Note that this first pressurization test only adds about 50 liters of argon to the 40,000 liters of air in the RICH vessel, so even a catastrophic leak in the (so far untested) vessel presents no ODH hazard to personnel.

- Measure the position of the center of the window support beams relative to a straight beam held across the front of the window.

- Charge the bubbler initially with silicone oil to a depth of 0.5" below the gas inlet tube. This will set

the pressure of the RICH, once gas is flowing, to 0.5" water above the ambient pressure.

- Set throttle T1 to closed.
- Set the gas inlet regulator R1 to 20 psi output pressure.
- Open manual valves V6 (manometer), V4, V3, V2, and V1. Make sure that V5 (vent to the room) is closed.
- Open throttle T1 until the flowmeter indicates 10 liters/min.
- Monitor the RICH pressure using the manometer. It should take about 5 minutes for the RICH pressure to reach 0.5" water above the ambient pressure and for the bubbler to start to discharge into the exhaust line. Continually check the RICH entrance and exit windows and their support beams for signs of mechanical distress during this period.
- If the pressure does not reach 0.5" in 10 minutes, there is a very large leak. Shut off the input flow and inspect the vessel until it is found.
- Stop the input gas flow by closing V2 when the bubbler starts to discharge gas into the exhaust line. Close V3 and V4 to completely isolate the RICH. This will leave the RICH pressurized to 0.5" of water above ambient.
- Carefully check the RICH windows and their support beams for signs of distress.
- Monitor the RICH pressure vs time for evidence of a large overall leak rate. A leak rate of 5 liters/hour would cause the RICH pressure to drop at a rate of 0.05" water per hour. Monitor the pressure for up to 2 hours to get an initial estimate of the overall leak rate. Monitor and record RICH pressure, barometeric pressure, and deflection of the beams every 15 minutes.

5.2 Leak checking with argon at 0.5" pressure

Following the initial pressurization and leak down test described in procedure 5.1, the next step is to flow argon gas into the RICH vessel while searching for leaks using the argon leak sniffer. Large leaks will be found and fixed early in the process, when the percentage of argon in the RICH vessel is small.

Search for leaks with the Argon leak sniffer by checking all Kapton window seals, all Kapton window seams, all hatch seals (access and high voltage hatches), all HV feedthroughs, and all signal feedthroughs.

- Close throttle T1. Open V4 (to the bubbler), V3 (gas inlet), V2 and V6. V5 should be closed.

- Slowly open throttle T1, monitoring the RICH pressure continuously, until the high volume flowmeter indicates a flow rate of 35 liters/min. In any case, the RICH pressure, as read from the manometer, should not exceed 0.9". If the pressure reaches 0.9" at a lower flow rate, use that lower flow rate to purge the RICH.

- Flow 35 liters/min of Argon through the RICH for 30 hours. At this point, the gas inside the RICH will be about 80% Argon and 20% air.

- Begin searching for leaks with the argon sniffer in the first hour. Fix large leaks as they are found.

- After 30 hours, slowly reduce the flowrate until the RICH pressure starts to drop, then increase it by 20%. Maintain that flowrate through the RICH while leak checking.

- Measure and record the deflection of the center of the window support beams.

5.3 Pressurization to 1.5" and leak checking

Once leak checking is complete at 0.5" (procedure 5.2), the RICH vessel is to be tested at 1.5" pressure (three times the design operating pressure) to establish that

it can tolerate that pressure, and that it does not leak at that pressure.

- Close V2, V3 and V4. This stops the gas flow, and isolates the bubbler from the RICH.

- Increase the silicone oil level in the bubbler to 1.5" above the gas inlet tube.

- Open V4, V3 and V2. This will resume flow at 10 liters/min, increasing the RICH pressure at a rate of 0.5" of water every 5 minutes. Monitor the RICH pressure continuously and pause 5 times, as described below.

- Pause the flow when the RICH pressure reaches 0.8", 1.0", 1.2", 1.4", and 1.5" above ambient pressure, by closing V2. At each pause, check the RICH windows and their support beams for signs of distress.

- At each pause, measure the deflection of the center of the window support beams and record the results. Stop the test if the deflection exceeds 0.25".

- Repeat with the Argon leak sniffer the check of all Kapton window seals, all Kapton window seams, all hatch seals (access and high voltage hatches), all HV feedthroughs, and all signal feedthroughs. Record locations of all leaks.

- Repair all leaks.

5.4 Pressure cycling tests

Once the leak check at 1.5" (procedure 5.3) is complete, pressure cycling tests are to be performed on the RICH vessel. The purpose is to demonstrate that the RICH windows can tolerate repeated cycling to 1.5" without excessive permanent stretching or failure.

- Stop the gas flow by closing V2.

- Depressurize the RICH through V5 (requires bleeding off roughly 150 liters of Argon).

- Measure and record the deflection of the center of the window support beams.

- Close V5 and open V2 to pressurize the RICH to 1.5" again. The flow rate should be 10 liters/min.

- Measure and record the deflection of the center of the window support beams.

- Cycle the pressure twice more, measuring and recording the window deflection each time.

- If the window deflection increases by more than 0.5" for any cycle, stop the test.

- Repeat with the Argon leak sniffer the check of all Kapton window seals, all Kapton window seams, all hatch seals (access and high voltage hatches), all HV feedthroughs, and all signal feedthroughs. Record the locations of all leaks.

- Repair all leaks found.

5.5 Measuring the dependence of volume on pressure

The RICH volume will depend on the pressure differential with respect to ambient, due to expansion of the windows. Any long term measurement of leak rate by observing pressure changes will require a knowledge of the dependence of the RICH volume on pressure. The purpose of this procedure is the measurement of data that can be used to deduce the change in RICH volume as the differential pressure changes.

Refer to figure 2 when reading procedure 5.5

- Pressurize the RICH to 1.5" and isolate it by closing valves V3, V4 and V5.

- Pump out the vacuum chamber. And isolate it from the vacuum pump by closing ~~V5~~ V7.

- Record the differential pressure between the RICH and ambient air, read from the manometer. Record the vacuum pressure in the vacuum chamber.

- Open valve V5 and bleed gas from the RICH into the vacuum chamber until the RICH pressure drops to 1.25". Close valve V5. Record the precise RICH pressure read from the manometer, and the vacuum chamber pressure.

- Bleed gas into the vacuum chamber, pausing at RICH pressure of 1.0", 0.75", 0.50", 0.25". Record the RICH pressure from the manometer and the vacuum chamber pressure at each interval.

5.6 Final leak down test

The purpose of this procedure is to establish a final leak rate for the RICH by measuring the pressure drop versus time for the isolated RICH.

Refer to figure 1 when reading this procedure.

- Pressurize the RICH to 1.5" and isolate it by closing V3, V4 and V5. Leave V6 (manometer) open.

- Record the following quantities at 30 minute intervals for 24 hours:

    - The RICH pressure (read from the manometer).
    - The barometric pressure.
    - The temperature.

6.0 Documentation

None

7.0 Attachments

7.1 Figure 1 - P&ID drawing of the gas system.

7.2 Figure 2 - Schematic showing system for calibration of RICH pressure versus volume.

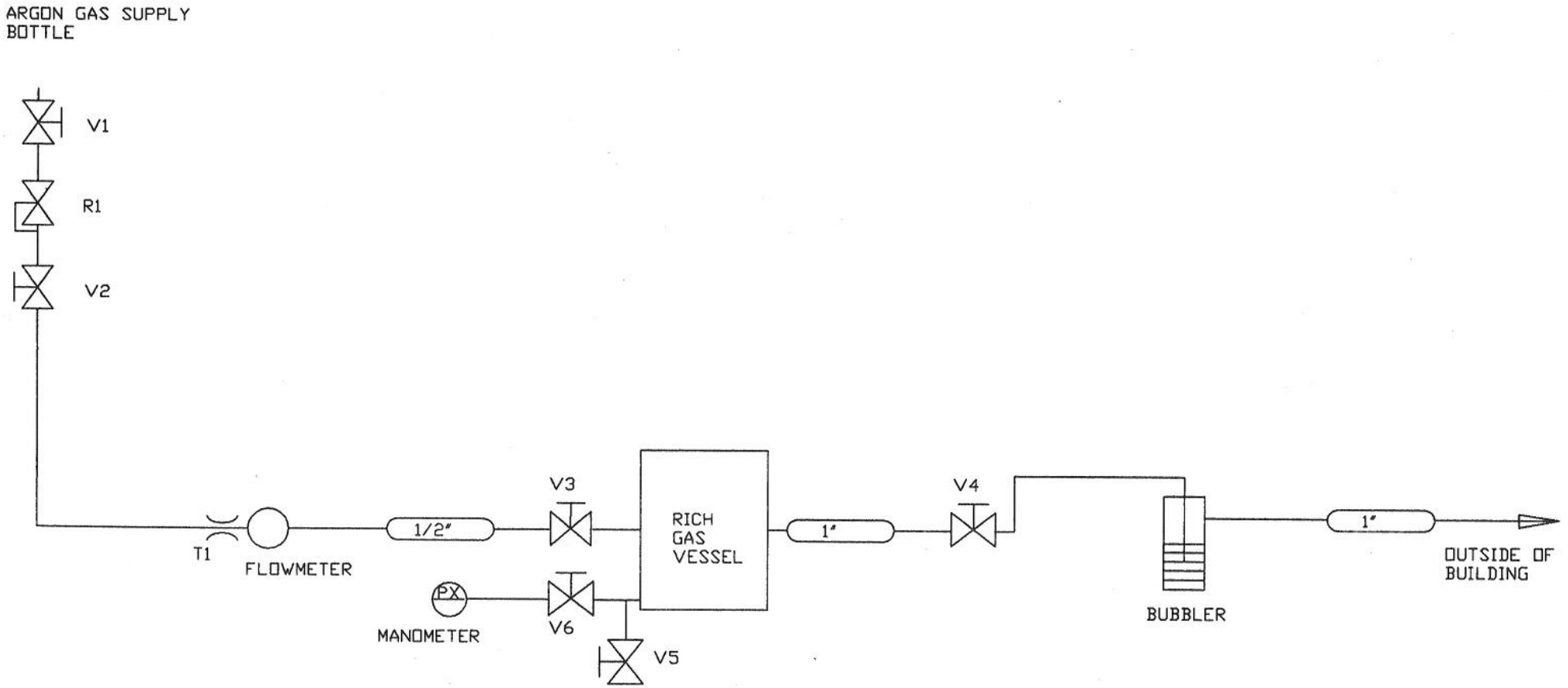

Figure 1. The gas system for leak checking the PHENIX RICH in building 832.

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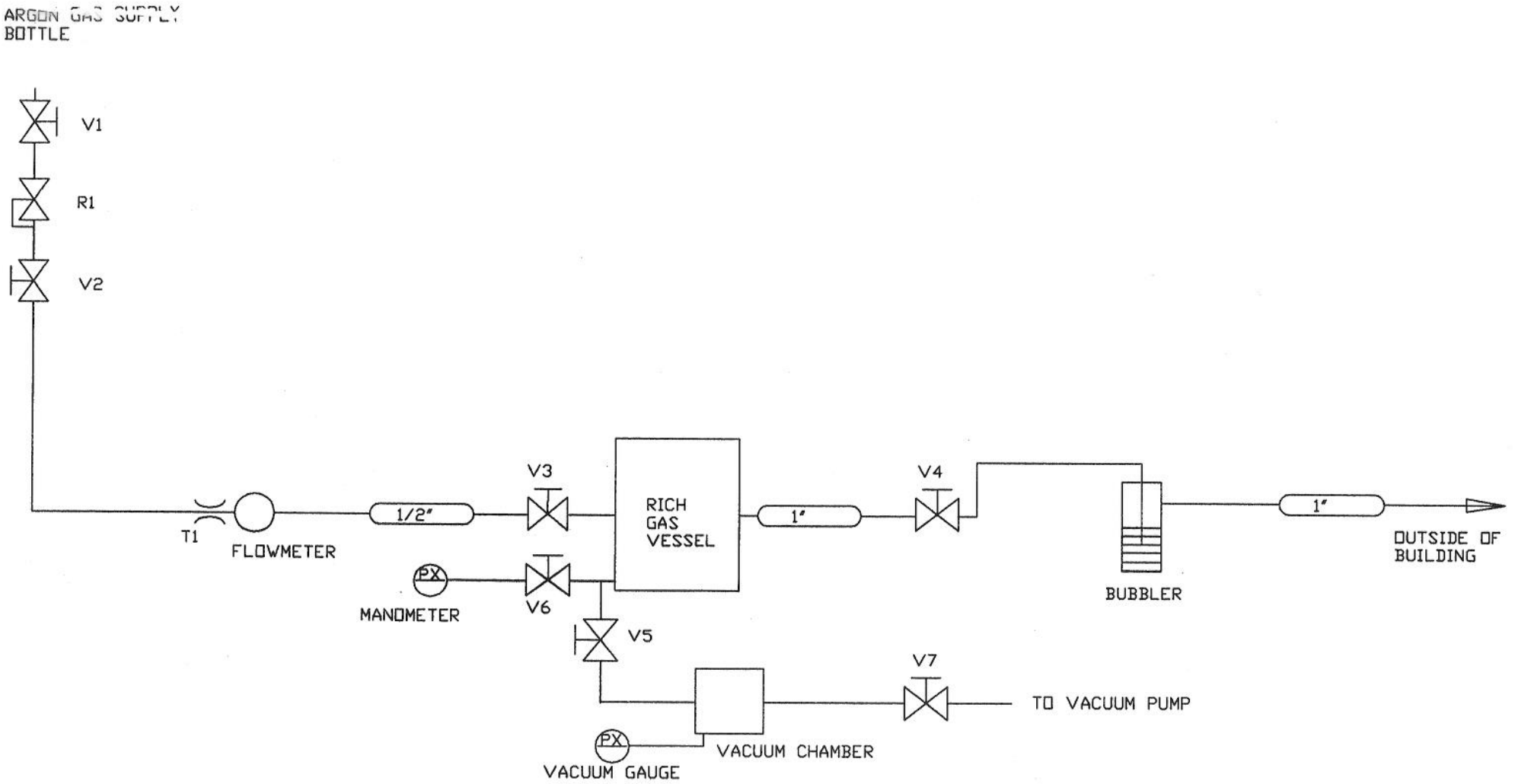

Figure 2. The gas system for leak checking the PHENIX RICH in building 832, with the vacuum chamber attached for calibrating volume versus pressure of the RICH.

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